

Table S. 1 Test methods according to the JIS Standards

Standard	Procedure
JIS A 1203 (2009): Test method for water content of soils	Determine the mass of the container. Place the soil sample in the container and determine the total mass. Place the container with the sample into a drying oven and dry at 110 ± 5 °C until a constant mass is reached. Transfer the oven dried sample (still in the container) to a desiccator and, after letting it to cool down to around room temperature, determine the total mass. The time to reach constant mass is usually between 18 and 24 hours. In our case, we let the sample dry for 24 hours.
JIS A 1226 (2009): Test method for ignition loss of soils	Determine the mass of the crucible. Place the oven-dried soil sample in the crucible and measure the total mass. Place the crucible in an electric muffle furnace and heat the sample gradually. Keep the temperature at 750 ± 50 °C for 1 hour. Move the crucible to a desiccator and, after it has cooled down to room temperature, measure the total mass. Repeat this procedure until constant mass is reached.
JIS 1202 (2009): Test method for density of soil particles	Determine the mass of a pycnometer. Fill the pycnometer with distilled water and determine the total mass and the water temperature in the pycnometer. Empty the pycnometer and add the soil sample to the pycnometer. Add distilled water until the total volume reaches two third of the pycnometer capacity. When using an oven-dried sample, after adding distilled water, allow it to soak for more than 12 hours. Bring the pycnometer to boil using boiling water bath and shake the pycnometer from time to time to allow air bubbles to escape. Once all the air has escaped, let the sample stand until it reaches room temperature. The boiling time should not be less than 10 minutes for common soil, 40 minutes approximately for highly organic soil and not less than 2 hours for volcanic ash soil. Fill the pycnometer with distilled water and determine the total mass and the temperature. Pour the content of the pycnometer in a container and dry it in the oven at 110 ± 5 °C until constant mass is reached (only for not oven-dried samples). Cool down the sample to room temperature in a desiccator and determine the mass.
JIS A 1204 (2009): Test method for particle size distribution of soils	<u>Sieving of soil sample with an aperture width of 2 mm:</u> Use wet or air-dried sample. Take approximately one-fourth of the sample and determine the water content of the soil sample. Take the total amount of remaining sample and weigh the mass of the sample. Sieve it through a sieve with an aperture width of 2 mm. <u>Sieving of the portion remaining of the sieve with an aperture width of 2 mm:</u> Wash the portion remaining on the sieve with aperture width of 2 mm with water on the sieve to wash away the soil

particles passing the sieve with an aperture width of 2 mm. Dry the total amount of sample remaining on the sieve in an oven at 110 ± 5 °C to constant mass and measure the mass of the sample. Sieve the oven-dried soil sample through sieves with an aperture width of 75 mm, 53 mm, 37.5 mm, 26.5 mm, 19 mm, 9.5 mm and 4.75 mm. Sieve the soil sample continuously for 1 minute until the portion passing the sieve becomes approximately 1% or less of the portion remaining on the sieve. Measure the weight of the soil sample remaining on each sieve and the mass of the sample passing the sieve with an aperture width of 4.75 mm.

Sedimentation analysis of the portion passing the sieve with an aperture width of 2 mm:

Take approximately 115 g of sandy soil, 65 g of silty or clayey soil as the sample. Take about one-fourth of the sample and determine the water content. Measure the amount of the remaining sample. Dispersion of soil samples shall be carried out according to the plasticity index:

- a. For samples less than 20 in plasticity index: Add distilled water to the sample contained in a beaker, stir and let the mixture stand for 15 hours or more. After that, transfer it to the dispersion device and add distilled water until the total volume is 700 mL. Add 10 mL of dispersing agent (saturated solution of hexametaphosphate) and stir for 1 minute.
- b. For samples not less than 20 in plasticity index: Add 100 mL of hydrogen peroxide 6% to the sample contained in a beaker and stir. Place glass plate cover on the beaker and put it inside the drying oven at 110 ± 5 °C. After 1 hour, take it out of the oven, add 100 mL of distilled water and let the mixture stand for 15 hours. After that, transfer it to the dispersion device and add distilled water until the total volume is 700 mL. Add 10 mL of dispersing agent (saturated solution of hexametaphosphate) and stir for 1 minute.

Transfer the total amount of dispersed sample to a measure cylinder and fill to 1 L with distilled water. Place the cylinder in a constant-temperature bath or constant-temperature room, let it stand until the temperature of the sample is the same as the bath or the room and stir from time to time. Place a cover on the measuring cylinder, turn it upside down and back to upright for 1 minute approximately and let it stand. Float the hydrometer (graduated in 0.001 g/cm³ division scale between 0.995 g/cm³ and 1.050 g/cm³) in the cylinder and take the reading of decimal part of the scale at the top of the meniscus to the nearest 0.0005 and the temperature of the suspension at the following intervals of time: 1, 2, 5, 15, 30, 60, 240 and 1440 minutes.

Sieve analysis of the portion passing the sieve with an aperture width of 2 mm and the portion remaining on the sieve with an aperture of 75 μm :

Take the total amount of sample used for sedimentation analysis as the sample, wash it with a sieve with aperture width of 75 μm with water and dry it in an oven at 110 ± 5 °C to a constant mass. Sieve the oven-dried sample through sieves with an aperture width of 850 μm , 425 μm , 250 μm , 106 μm and 75 μm . Weight the mass of sample retained on each sieve.

Table S. 2 Parameters measured for soils A, B, and C

	Soil A	Soil B	Soil C	Soil D
pH	X	X	X	X
EC	X	X	X	X
Cr (VI)	X	BDL	NA	NA
Pb	X	BDL	X	BDL
As	X	X	X	X
Se	X	X	BDL	X
Cu	X	X	X	X
F	X	X	X	BDL
B	NA	NA	NA	X
Mg	NA	X	NA	NA
Cl	NA	X	NA	NA
DOC	NA	X	NA	NA

NA: not available

BDL: below detection limit

Detection limits: 0.005 mg/L for Cr (VI); 0.001 mg/L for Pb, As, Se, Cu; 0.08 mg/L for F; 0.01 mg/L for B; 0.5 mg/L for Mg; 0.1 mg/L for Cl; and 1 mg/L for DOC

Table S. 3 Test conditions of the participating laboratories in the column percolation tests for soil A

	Units	Lab 1a	Lab 1b	Lab 1c	Lab 1d	Lab 2a	Lab 2b	Lab 3a	Lab 3b
Fill volume	cm ³	595	595	595	595	583	585	609	609
Internal diameter	cm	5	5	5	5	4.97	4.98	5	5
Fill Height	cm	30.3	30.3	30.3	30.3	30.13	30	31	31
Sample dry mass	g	492	492	492	494	519	516	489	490
Bulk density	g/cm ³	0.83	0.83	0.83	0.83	0.89	0.88	0.80	0.80
Flow Rate	mL/h	11.1	13	36	36	36.1	36.3	36	36
Saturation time	h	48	16	48	12	48	0	48	0
Contact time	h	37.5	32.0	11.6	11.5	10.9	10.9	12.0	12.0

Table S. 4 Test conditions of the participating laboratories in the column percolation tests for soil B

	Units	Lab 1a	Lab 1b	Lab 1c	Lab 1d
Fill volume	cm ³	571	558	593	562
Internal diameter	cm	5	5	5	5
Fill height	cm	29.1	28.4	30.2	28.6
Sample dry mass	g	680	680	679	679
Bulk density	g/cm ³	1.19	1.22	1.15	1.21
Flow Rate	mL/min	12.4	36	36	36
Saturation time	h	48	16	48	0
Contact time	h	26.1	8.6	9.6	8.7

Table S. 5 Test conditions of the participating laboratories in the column percolation tests for soil C

	Units	Lab 1a	Lab 1b	Lab 1c	Lab 1d	Lab 4a	Lab 4b	Lab 5a	Lab 5b	Lab 6a	Lab 6b
Fill volume	cm ³	595	595	595	595	626	624	557	525	589	589
Internal diameter	cm	5	5	5	5	5	5	4.98	4.97	5	5
Fill height	cm	30.3	30.3	30.3	30.3	31.9	31.9	28.46	28.1	30	30
Sample dry mass	g	797	808	809	793	784	797	736	744	804	740
Bulk density	g/cm ³	1.34	1.36	1.36	1.33	1.25	1.27	1.33	1.36	1.37	1.26
Flow rate	mL/h	12.1	11.3	37	33	36	36	36	36	36	36
Saturation time	h	48	16	48	16	48	0	48	0	48	0
Contact time	h	24.2	25.6	7.8	8.9	9.1	9.0	7.7	6.8	7.9	8.6

Table S. 6 Test conditions of the participating laboratories in the column percolation tests for soil D

	Units	Lab 1a	Lab 1b	Lab 1c	Lab 1d
Fill volume	cm ³	589	589	589	589
Internal diameter	cm	5	5	5	5
Fill height	cm	30	30	30	30
Sample dry mass	g	501	501	501	499
Bulk density	g/cm ³	1.19	1.22	1.15	1.21
Flow rate	mL/h	12.4	36	36	36
Saturation time	h	48	48	16	0
Contact time	h	32.7	11.3	11.3	11.3

1 **Table S. 7 Comparison between concentration of original and modified methods**

Soil	Analyte	Concentration original method (48 h – 12 mL/h)							Concentration modified method (12-16 h – 36 mL/h)							Ratio modified concentration/original concentration						
		LS 0.1	LS 0.2	LS 0.5	LS 1	LS 2	LS 5	LS 10	LS 0.1	LS 0.2	LS 0.5	LS 1	LS 2	LS 5	LS 10	LS 0.1	LS 0.2	LS 0.5	LS 1	LS 2	LS 5	LS 10
A	pH	8.6	8.9	9.1	9.1	9.1	8.3	7.8	9.0	9.1	9.1	9.2	9.2	8.8	8.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0
	EC (mS/m)	445	454	440	294	203	104	66	308	301	369	291	203	109	64	0.7	0.7	0.8	1.0	1.0	1.1	1.0
	Cr VI (mg/L)	14	15	15	12	12	9.3	5.9	13	12	14	12	11	8.7	5.4	0.9	0.8	0.9	1.0	0.9	0.9	0.9
	Pb (mg/L)	0.0290	0.0360	0.0430	0.0280	0.0170	0.0058	0.0008	0.0180	0.0180	0.0310	0.0270	0.0160	0.0054	0.0012	0.6	0.5	0.7	1.0	0.9	0.9	1.5
	As (mg/L)	0.0150	0.0150	0.0160	0.0100	0.0069	0.0030	0.0016	0.0120	0.0120	0.0150	0.0110	0.0069	0.0033	0.0016	0.8	0.8	0.9	1.1	1.0	1.1	1.0
	Se (mg/L)	0.0048	0.0050	0.0051	0.0028	0.0014	0.0005	0.0004	0.0023	0.0024	0.0048	0.0035	0.0015	0.0006	0.0003	0.5	0.5	0.9	1.3	1.1	1.2	0.8
	Cu (mg/L)	0.110	0.120	0.120	0.077	0.055	0.030	0.025	0.085	0.082	0.110	0.084	0.056	0.030	0.020	0.8	0.7	0.9	1.1	1.0	1.0	0.8
	F (mg/L)	0.38	0.38	0.43	0.51	0.69	1.40	1.70	0.50	0.50	0.41	0.43	0.63	1.30	1.70	1.3	1.3	1.0	0.8	0.9	0.9	1.0
B	pH	7.0	6.9	6.7	6.9	6.8	6.8	6.8	7.2	7.2	6.8	6.8	6.8	6.7	6.6	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	EC (mS/m)	78.4	74.3	62.3	47.3	38.9	33.8	31.3	80.3	76.8	60.6	45.3	36.9	32.3	30.6	1.0	1.0	1.0	1.0	0.9	1.0	1.0
	As (mg/L)	0.0260	0.0210	0.0190	0.0170	0.0150	0.0150	0.0130	0.0240	0.0210	0.0180	0.0160	0.0130	0.0100	0.0100	0.9	1.0	0.9	0.9	0.9	0.7	0.8
	Se (mg/L)	0.3300	0.2700	0.1700	0.0620	0.0250	0.0081	0.0039	0.3300	0.3000	0.1700	0.0610	0.0220	0.0073	0.0033	1.0	1.1	1.0	1.0	0.9	0.9	0.8
	Cu (mg/L)	0.0029	0.0025	0.0025	0.0019	0.0016	0.0016	0.0014	0.0027	0.0026	0.0023	0.0019	0.0015	0.0011	0.0010	0.9	1.0	0.9	1.0	0.9	0.7	0.7
	F (mg/L)	4.0	3.7	3.7	4.0	4.3	4.1	4.1	4.1	3.6	3.6	4.1	4.3	4.3	4.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Mg (mg/L)	7.0	4.7	3.3	2.3	1.8	1.4	1.2	7.4	4.9	3.3	2.3	1.7	1.4	1.2	1.1	1.0	1.0	1.0	0.9	1.0	1.0
	DOC (mg/L)	6.2	3.7	3.4	2.0	2.6	2.1	1.9	6.8	4.0	2.4	1.8	2.0	2.1	1.1	1.1	1.1	0.7	0.9	0.8	1.0	0.6
C	pH	3.0	3.1	3.2	3.5	3.8	4.0	3.8	3.2	2.9	2.9	3.3	3.7	3.9	4.1	1.1	0.9	0.9	1.0	1.0	1.0	1.1
	EC (mS/m)	609	538	375	152.6	41.5	34.5	35.4	631	614	439	176.1	46.5	35.1	32.1	1.0	1.1	1.2	1.2	1.1	1.0	0.9
	Pb (mg/L)	0.0110	0.0072	0.0060	0.0028	0.0014	0.0010	0.0011	0.0220	0.0130	0.0086	0.0031	0.0018	0.0014	0.0005	2.0	1.8	1.4	1.1	1.3	1.4	0.5
	As (mg/L)	0.0560	0.0380	0.0190	0.0034	0.0002	0.0002	0.0001	0.0670	0.0650	0.0370	0.0068	0.0008	0.0004	0.0002	1.2	1.7	1.9	2.0	4.0	2.0	2.0
	Cu (mg/L)	0.1200	0.1300	0.0780	0.0140	0.0022	0.0012	0.0004	0.2800	0.2900	0.2000	0.0370	0.0034	0.0015	0.0006	2.3	2.2	2.6	2.6	1.5	1.3	1.5
	F (mg/L)	0.77	0.20	0.08	0.08	0.08	0.08	0.08	1.40	0.14	0.36	0.08	0.13	0.09	0.10	1.8	0.7	4.5	1.0	1.6	1.1	1.3
D	pH	8.8	9.0	8.5	8.9	8.9	7.6	7.7	9.0	9.1	9.0	9.0	9.1	8.4	7.6	1.0	1.0	1.1	1.0	1.0	1.1	1.0
	EC (mS/m)	1318	1103	754	506	285	249	244	1187	1074	827	493	266	246	243	0.9	1.0	1.1	1.0	0.9	1.0	1.0
	As (mg/L)	0.1400	0.1200	0.0700	0.0510	0.0190	0.0110	0.0082	0.1200	0.1100	0.0810	0.0420	0.0130	0.0083	0.0076	0.9	0.9	1.2	0.8	0.7	0.8	0.9
	Se (mg/L)	0.0160	0.0150	0.0086	0.0058	0.0010	0.0006	0.0004	0.0130	0.0110	0.0110	0.0051	0.0006	0.0003	0.0003	0.8	0.7	1.3	0.9	0.6	0.5	0.8
	Cu (mg/L)	0.990	0.920	0.570	0.410	0.140	0.062	0.037	1.000	0.920	0.660	0.400	0.100	0.051	0.032	1.0	1.0	1.2	1.0	0.7	0.8	0.9
	B (mg/L)	0.68	0.54	0.27	0.18	0.12	0.10	0.11	0.68	0.47	0.24	0.15	0.10	0.09	0.09	1.0	0.9	0.9	0.8	0.8	0.9	0.8

2 **Table S. 8 Comparison between cumulative release of original and modified methods**

Soil	Analyte	Cumulative release original method (48 h – 12 mL/h)							Cumulative release modified method (12-16 h – 36 mL/h)							Ratio modified cumulative release/original cumulative release						
		LS 0.1	LS 0.2	LS 0.5	LS 1	LS 2	LS 5	LS 10	LS 0.1	LS 0.2	LS 0.5	LS 1	LS 2	LS 5	LS 10	LS 0.1	LS 0.2	LS 0.5	LS 1	LS 2	LS 5	LS 10
A	Cr VI (mg/kg)	1.2	2.4	7.5	12.9	25.9	52.7	82.4	1.6	2.6	7.0	14.4	23.9	49.5	77.4	1.4	1.1	0.9	1.1	0.9	0.9	0.9
	Pb (mg/kg)	0.0024	0.0054	0.0199	0.0327	0.0510	0.0677	0.0718	0.0022	0.0038	0.0134	0.0301	0.0439	0.0598	0.0660	0.9	0.7	0.7	0.9	0.9	0.9	0.9
	As (mg/kg)	0.0013	0.0025	0.0079	0.0124	0.0199	0.0285	0.0366	0.0015	0.0025	0.0071	0.0140	0.0199	0.0296	0.0379	1.2	1.0	0.9	1.1	1.0	1.0	1.0
	Se (mg/kg)	0.0004	0.0008	0.0025	0.0038	0.0053	0.0068	0.0088	0.0003	0.0005	0.0020	0.0041	0.0054	0.0072	0.0088	0.7	0.6	0.8	1.1	1.0	1.1	1.0
	Cu (mg/kg)	0.009	0.019	0.059	0.095	0.154	0.240	0.367	0.011	0.017	0.052	0.104	0.152	0.240	0.344	1.1	0.9	0.9	1.1	1.0	1.0	0.9
	F (mg/kg)	0.032	0.063	0.208	0.441	1.186	5.215	13.795	0.062	0.104	0.231	0.498	1.041	4.865	13.653	1.9	1.7	1.1	1.1	0.9	0.9	1.0
B	As (mg/L)	0.0026	0.0047	0.0104	0.0189	0.0325	0.0771	0.1436	0.0024	0.0045	0.0098	0.0176	0.0308	0.0613	0.1122	0.9	1.0	0.9	0.9	0.9	0.8	0.8
	Se (mg/L)	0.0332	0.0602	0.1110	0.1420	0.1647	0.1888	0.2088	0.0330	0.0632	0.1131	0.1427	0.1651	0.1874	0.2041	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Cu (mg/L)	0.0003	0.0005	0.0013	0.0022	0.0037	0.0084	0.0156	0.0003	0.0005	0.0012	0.0021	0.0037	0.0070	0.0121	0.9	1.0	0.9	1.0	1.0	0.8	0.8
	F (mg/L)	0.40	0.77	1.88	3.88	7.79	19.96	40.96	0.41	0.77	1.83	3.82	8.20	21.31	41.67	1.0	1.0	1.0	1.0	1.1	1.1	1.0
	Mg (mg/L)	0.70	1.17	2.16	3.31	4.95	9.10	15.25	0.74	1.23	2.20	3.32	5.05	9.32	15.43	1.1	1.1	1.0	1.0	1.0	1.0	1.0
	DOC (mg/L)	0.6	1.0	2.0	3.0	5.4	11.6	21.3	0.7	1.1	1.8	2.7	4.7	11.1	16.7	1.1	1.1	0.9	0.9	0.9	1.0	0.8
C	Pb (mg/kg)	0.0011	0.0018	0.0036	0.0048	0.0064	0.0092	0.0146	0.0018	0.0029	0.0052	0.0069	0.0084	0.0128	0.0154	1.7	1.7	1.4	1.5	1.3	1.4	1.1
	As (mg/kg)	0.0056	0.0091	0.0149	0.0163	0.0165	0.0171	0.0176	0.0056	0.0109	0.0206	0.0245	0.0252	0.0264	0.0275	1.0	1.2	1.4	1.5	1.5	1.5	1.6
	Cu (mg/kg)	0.0120	0.0238	0.0478	0.0536	0.0561	0.0595	0.0615	0.0233	0.0470	0.0995	0.1208	0.1235	0.1283	0.1314	1.9	2.0	2.1	2.3	2.2	2.2	2.1
	F (mg/kg)	0.08	0.10	0.12	0.15	0.24	0.47	0.86	0.12	0.13	0.22	0.27	0.37	0.66	1.17	1.5	1.3	1.9	1.8	1.5	1.4	1.4
D	As (mg/kg)	0.0144	0.0262	0.0467	0.0715	0.0903	0.1227	0.1634	0.0126	0.0237	0.0485	0.0699	0.0831	0.1082	0.1464	0.9	0.9	1.0	1.0	0.9	0.9	0.9
	Se (mg/kg)	0.0016	0.0031	0.0056	0.0085	0.0095	0.0112	0.0132	0.0014	0.0025	0.0058	0.0084	0.0090	0.0100	0.0115	0.8	0.8	1.0	1.0	1.0	0.9	0.9
	Cu (mg/kg)	0.1016	0.1920	0.3590	0.5590	0.6973	0.8799	1.0633	0.1048	0.1980	0.4000	0.6038	0.7049	0.8593	1.0204	1.0	1.0	1.1	1.1	1.0	1.0	1.0
	B (mg/kg)	0.070	0.123	0.202	0.290	0.408	0.703	1.248	0.071	0.119	0.192	0.269	0.370	0.633	1.066	1.0	1.0	1.0	0.9	0.9	0.9	0.9

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